Improving Inter-Scene Radiometric Fusion Through Haze Correction and Invariant Targets

B. Guindon[1] and Y. Zhang[2]

[1]Canada Centre for Remote Sensing
588 Booth Street
Ottawa, CANADA
[2] Noetix Research Inc.

ABSTRACT

Conventional image mosaic generation utilizes pixels in inter-scene overlap regions to define linear normalization coefficients for radiometric balancing purposes. Pixels used for this purpose are referred to as 'characteristic' pixels, implying that their group properties are characteristic of the parent scene as a whole. The success of this normalization approach requires that the radiometry of these pixels exhibit both spatial and temporal stationarity. Spatial stationarity can be compromised if one or both scenes suffer from spatially-distributed haze, a problem which is most acute in the case of visible-band imagery. Normalization in the presence of haze may result in a correct 'mean' adjustment for the overlap region but may be inadequate if (a) the haze in this region is not representative of the whole scene or (b) the residual radiometric fluctuations due to haze is significant.

In the case of satellite imagery, low re-visit cycles generally require that scenes with very different acquisition dates be fused (i.e. differing by months to years). In regions where most land cover is temporally stable (e.g. remote forest areas), conventional normalization should produce good, relative radiometric continuity. Problems arise when temporal stationarity is not met, for example, where the overlap regions are dominated by surface classes such as agricultural crops that show significant seasonal or inter-annual variability. While normalization can still produce a 'visually pleasing' mosaic, radiometric continuity of temporally stationary targets such as forests may be compromised.

Based on the above arguments we propose an alternate approach for inter-scene normalization. First, scene-based haze suppression is applied to each scene based on the Haze Optimized Transform (HOT). This procedure is in effect an intra-scene normalization process resulting not only in haze removal but also reduction in low frequency radiometric trends associated with solar illumination, viewing geometry and BRDF effects. Second, characteristic pixels used for normalization are selected not on statistical grounds (e.g. based on regression analyses) but rather are limited to a-priori selected regions of temporally invariant targets such as forests and urban/developed centres. Normalization test comparisons (i.e. conventional vs. proposed methodologies) using scene sets selected from the Great Lakes region are described.